Final Report for Period: 05/2008 - 04/2009 **Submitted on:** 07/29/2009
Principal Investigator: Conrad, Leyla . **Award ID:** 0401979
Organization: GA Tech Res Corp - GIT
Submitted By:
Conrad, Leyla - Principal Investigator
Title:
STEP-UP: Summer Teacher Experience in Packaging, Utilizing Physics -- "RET Site"

Project Participants

Senior Personnel

Name: Conrad, Leyla
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Conrad, Edward
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Auerbach, Jill
Worked for more than 160 Hours: Yes
Contribution to Project:
She developed the assessment tools, administered and analyzed the surveys, and organized the focus group sessions. She is supported by this project.

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Atlanta Public Schools

Cobb County School District

Fulton County Schools

Clayton County Public Schools

DeKalb County School Systems

Gwinnett County Public Schools

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Findings: (See PDF version submitted by PI at the end of the report)

Training and Development:
Covered in detail in the activities section.

Outreach Activities:
Covered in the activities section.

Journal Publications

Books or Other One-time Publications

Leyla Conrad, Ed Conrad, Jill Auerbach, "The Development, Implementation and Assessment of an Engineering Research
Experience for Physics Teachers", (2007). Conference proceedings, Published
Collection: Proceedings of ASEE Annual Conference
Bibliography: June 23-27

Web/Internet Site

URL(s):
www.ece.gatech.edu/academics/outreach/step-up/index.html
Description:

Other Specific Products

Product Type:
Teaching aids
Product Description:
Thirty six lesson plans in the area of modern physics or electricity & magnetism are developed by the physics teachers who participated in the STEP-UP program since 2004.
Sharing Information:
Lesson plans are located on a public web site and accessible by all interested parties

www.ece.gatech.edu/academics/outreach/step-up/lesson_plans/index.html

Contributions

Contributions within Discipline:

All the past participants have been using or planning to use the developed lesson plans that grew out of the STEP-UP experience. Several teachers conducted class field trips to Georgia Tech and are planning them for future dates as well. Other data that is indicative of the impact of STEP-UP is the dissemination of materials acquired during the STEP-UP in the schools of the participants. Several teachers stated that they shared engineering educational flyers with others at their schools, shared the engineering career video they received from the STEP-UP program director, and they used materials from STEP-UP for classroom display purposes.

Contributions to Other Disciplines:

Summer research experience transferred to physics classrooms via lesson plans developed during the experience and equipment and teaching tools purchased by the participants.
These resources are also shared by the chemistry and science teachers within the same school as well.

Contributions to Human Resource Development:

Teachers' summer research experience are transferred to their classroom which eventually their students benefit from. With the expertise they gained through their STEP-UP training and the tools they acquired, the teachers now serve their students better. Several teachers commented that their students are now more attentive in the classroom and comprehend the difficult concepts much easier because of the teaching techniques they developed during their STEP-UP experience.

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Conference Proceedings

Categories for which nothing is reported:

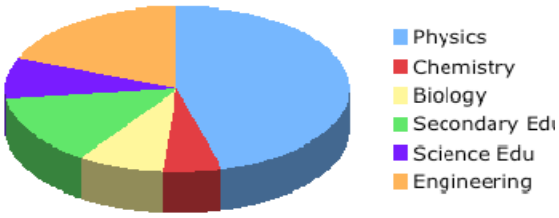
Any Journal

Contributions: To Any Resources for Research and Education

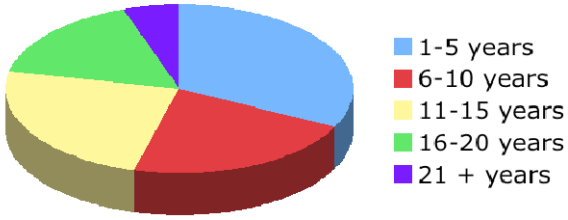
Contributions: To Any Beyond Science and Engineering

Any Conference

Since 2004, 36 teachers from 35 different high schools from 6 metro Atlanta school systems participated in the program. 30% of the teachers were underrepresented minority and 43% were female.

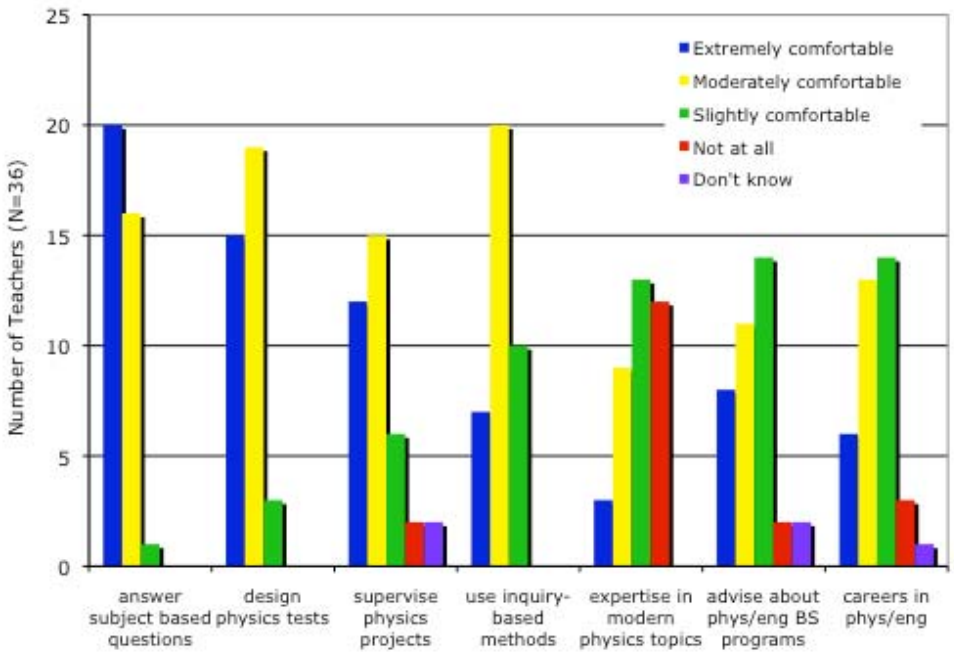


Participating Teachers' Educational Background



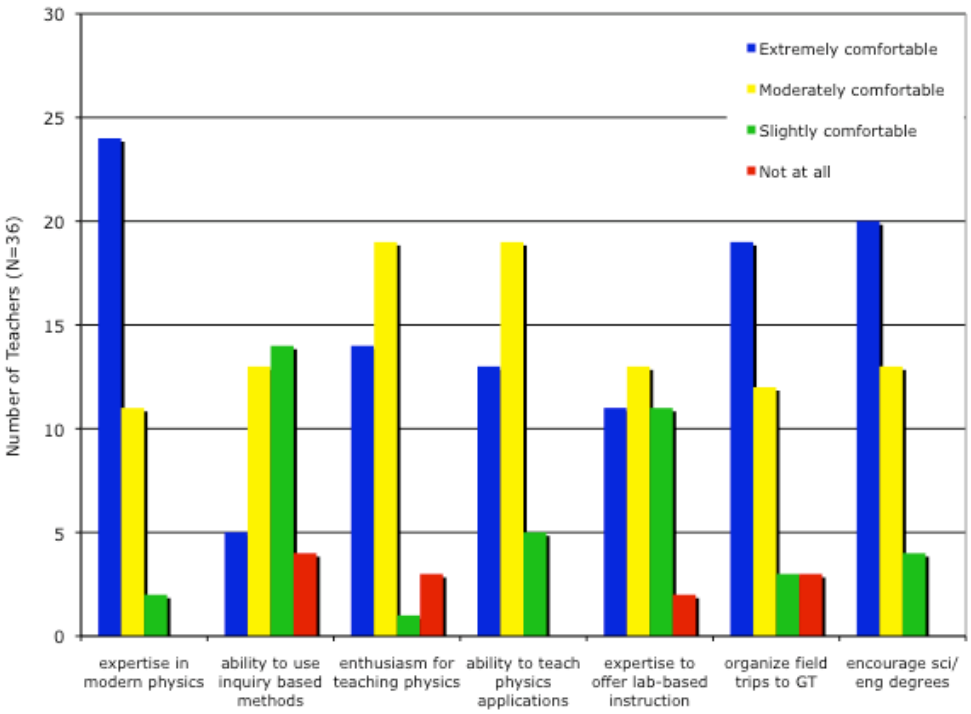
Number of Years Teaching Experience

The STEP-UP comprehensive assessment plan included the evaluation of the individual components of the program, the overall impact of the program on the participants' knowledge and skills, and the extent teachers transferred the newly acquired knowledge and skills to their students during the school year. At the beginning of the program, according to the pre-program survey results 70% of the teachers were not comfortable with the modern physics topics. Similarly, a large fraction of them were not familiar with the physics and engineering undergraduate programs and careers.



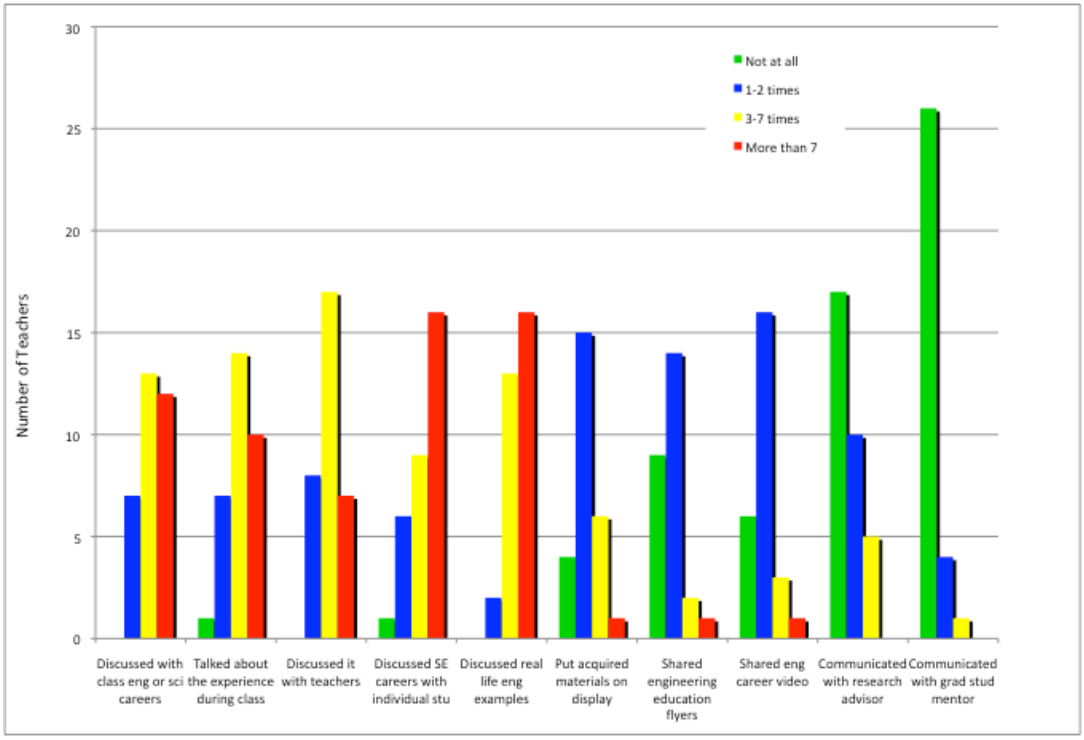
Pre-program survey results (2004-2008)

At the end of the program, all participants reported a high level of satisfaction with their summer experience. The pre- and post-test results showed about 30% increase in teachers' modern physics and technology knowledge. They were very excited of being part of a research group and learning how physics and microelectronics are related. They left the program with increased awareness and enthusiasm for the engineering field and careers.



Post-program survey results (2004-2008)

In order to track the specific activities that are undertaken during the school year a “utilization questionnaire” has been developed and administered to participants during the academic year following their summer research experience. The responses are provided in the following chart.



Academic year survey results (2004-2008)

According to the survey results,

- All the participants (97%) discussed or presented their summer experience to their students.
- All the teachers (100%) discussed real life engineering examples during class.
- 50% of the teachers used the lesson plans they developed during the summer.
- 31% of the teachers established engineering clubs at their schools and/or became advisor to such existing clubs
- All the teachers (100%) discussed with their students engineering and science careers.
- 75% of the participants shared engineering education flyers, materials and careers video they acquired from the STEP-UP program with their students.
- Over the past four years 15 high school groups visited the Georgia Tech campus and ECE students visited 4 high schools to present demos and give presentations at teachers' classrooms.

In the following sections, the individual assessment tool and survey results from the last offering are included.

(A) STEP-UP: Findings 2008 Pre-Program Survey
Administered June 2, 2008 at Program Orientation
N=6

ID	# of years teaching at current school:	# of years teaching high school:	# of years teaching H.S. physics:	# of years teaching non-physics H.S. science
801	2	19	19	2
802	3	3	3	0
803	2	2	2	0
804	4	6	4	0
805	3	5	4	1
806	1	20	20	20

During the last five years, have you been employed in any of the following settings?

	No	Yes; please specify
Laboratory related to science	5	1- Gift program research in China
Industry related to science	5	1- Part time developing web based graphing tool
Science research center	5	1- at Georgia Tech

Are you currently pursuing an advanced degree?

No	Yes; specify degree type and institution
4	1; Doctorate in Education 1; Educational Specialist - LMN

How many, if any, professional development programs have you attended in the last 3 years (2006 – 2008) that covered the following topics?

Professional Development Topics	none	1	2	3	over 3
Physics concepts and/or theory	4	2			
Physics curriculum development	2	2		2	
Physics classroom materials	5	1			
Classroom instructional techniques	2	1	2		2
Science research laboratory skills	4	2			

How confident do you feel in each of the following areas as each relates to you as a high school physics teacher?

	Extremely confident	Moderately confident	Slightly confident	Not confident	Do not know
Possess expertise in physics concepts		4	2		
Use inquiry-based instructional method		5	1		
Pace instruction to cover material		5	1		
Lead class discussion on text material	4	2			
Answer subject-based student questions	4	2			
Design physics tests	4	2			
Select physics text books	3	1	2		
Supervise student physics projects	3	3			
Advise students about physics programs	1	3	2		
Advise students about careers in physics	1	5			

Below is a list of various teaching objectives. In terms of your experience teaching high school physics, how challenging is teaching each of these areas in your physics courses? Please base your responses on your experience in non-AP Physics courses.

	Not	Challenging	Challenging	Very	Extremely

	applicable to class	but usually or always attainable	but typically attainable	challenging and often unattainable	challenging to the point of unattainable
Effectively teaching physics facts and concepts		3	3		
Showing the link between physics theory and practice		2	2	2	
Identifying appropriate hands-on activities		1	4	1	
Implementing hands-on activities to teach physics			5	1	
Identifying writing assignments for physics instruction		2	1	2	1
Implementing writing assignments for physics		1	1	4	
Stimulating class discussion on physics topics		2	4		
Identifying appropriate small group physics projects		1	5		
Implementing small group physics projects		1	3	2	
Increasing student interest in physics			1	4	1

Listed below are a variety of teaching strategies that can be used to teach high school physics. This question has two parts. In the first, please indicate the extent to which you use each of the teaching strategies listed below. In the last column, please check any strategies that you would like to use more often.

Teaching strategies	Regularly use	Sporadically use	Never or rarely use	Check (√) if would like to use more often
Pretest at the beginning of a new unit or book chapter		4	2	3
Lecture style instruction on text material	3	2	1	1
Class discussion on text material	3	1	2	1
Lecture style instruction on applied physics	3	3		
Class discussion on applied physics	2	2	2	2
Class discussion on real-life problems relevant to topics	4	2		3
Student log-books or journals	2	2	2	
Small-group written assignments	1	4	1	1
Small-group hands-on projects	5		1	1
Small-group oral presentations	2	3	1	1
Individual written assignments	3	3		1
Individual hands-on projects	3	3		
Individual oral presentations	2	3	1	1

STEP-UP Expectations

As you know, the STEP-UP program has several components. How concerned are you about the possible demands of the program?

	Very concerned	Somewhat concerned	A little concerned	Not at all concerned
Quantity of reading materials	1		3	2
Level of reading materials	1		3	2
Pace of lectures		2	3	1
Working in research lab	1	2	1	2
Attending follow-up workshops	1		1	4

Below is a list of possible skills or expertise that you can gain from your experience in STEP-UP. In terms of what you expect to learn from this program, how much emphasis do you think should be placed on each area in terms of instructional time?

	Extensive emphasis	Moderate Emphasis	Some emphasis	Minimal emphasis	Little or no emphasis
Modern physics concepts	2	3	1		
Application of modern physics to microelectronics	3	3			
Principles of microelectronic packaging & technologies	1	4	1		
Microelectronics research techniques	1	5			
Research-based course material for high school	2	4			
State-of-the-art packaging equipment/facilities	1	3	2		

Open ended question
Description of other professional development programs that was helpful:

Respondent 1 – Strong class session – gave me different techniques and methods to use in my classroom. Online book survey on "Whatever it Takes." This book was a discussion on line and reading through the book helped me to understand different methods of teaching.
Respondent 2 – AP Institute workshop held by College Board was very good. Relevant to high school and details about AP exam content & grading was excellent.
Respondent 3 – AP Physics certification
Respondent 4 – AP and IB Physics workshops that provided good overview of the course along with helpful practices
Respondent 5 – AP Physics workshop (1) discovering what was expected of me and students pertaining to coursework and (2) Instructors anecdotes of what works and what doesn't in labs and (3) other teacher sharing of techniques and labs
Respondent 6 – Differentiating instructions and gifted development program

(B) STEP-UP 2008: Findings Pre-Test/Post-Test Two-Week Modern Physics Course Administered In-Class (Ed Conrad)
N=5

Purpose of the pre-test/post-test format was to measure knowledge and skills gained by the participants over the two-week course. The tests were organized by 4 course topics that. Below is a summary of pre-test courses, post-test courses and gain.

Comparison of Pre-Test and Post-Test Number and Percentage Correct for Two Week Modern Physics Course

	Total Correct Scores N=165 test items		**Percentage Correct by Course Topic**			
	#	**%**	**Topic Waves N=20**	**Modern Physics N=40**	**Condensed Matter N=50**	**Technology N=55**
Pre-test	48.8	29.6	37.0%	45.5%	15.2%	28.4%
Post-test	96.20	58.3	80.0%	53.0%	60.8%	52.0%
Change	**47.4**	**28.7**	**43%**	**7.5%**	**45.6%**	**23.6%**

(C) STEP-UP: Findings End-of Course Evaluation Survey Data & Comments

Administered June 19, 2008 (N varied with question)

Approximate number of times you experienced each of the following situations. Please check the column to indicate your response.

	Never	Once or twice	More than two, less than six	More than six, less than ten	Ten or more times
Asked for clarification during or after physics class	0	1	2	1	1
Read additional material about course content	0	2	1	1	1
Accessed internet sites related to course content	0	2	0	1	2
Did not understand material covered during lecture	2	2	1	0	0
Did not understand material covered during lab	2	3	0	0	0
Discussed H.S. lesson plans with other participants	0	0	3	1	0
Discussed H.S. lesson plans with physics instructor	0	2	1	1	0
Made written notes for H.S. lesson plan ideas		2	1	0	1

To what extent did your experience in the Modern Physics course impact your confidence to perform in each of the following areas as it relates to you as a high school physics teacher?

	Greatly increased confidence	Moderately increased confidence	Minimally increased confidence	No impact
Possess expertise in modern physics concepts useful for teaching	4	1	0	0
Use of inquiry-based instructional method	2	3	0	0
Ability to pace instruction to cover material	2	2	0	1
Lead class discussion on text material	2	3	0	0
Answer subject-based student questions	4	1	0	0
Design physics tests	1	2	1	0
Select physics text books	2	3	0	0
Supervise student physics projects	3	1	1	0

Advise students about physics programs of study	3	2	0	0
Advise students about careers in physics	3	2	0	0

For each of the activities listed below, please indicate if there was too much time allotted for each area, about the right amount of time or more time was needed. Use the not applicable category for any activities that you may have missed.

	Too much	About right	Needed more	Not applicable
First day orientation program	0	5	0	0
Time for program-related questions on first day	0	4	0	1
Amount of lecture time (physics course)	0	5	0	0
Amount of lab time	0	4	0	1
Time for course-related questions during class	0	4	1	0
Time for course-related questions outside of class	0	5	0	0
Down-time with program participants	0	3	1	1
Discussion-time about electronic-portfolio	0	1	3	1

Please rate the effectiveness of each following program characteristics.

Effectiveness of……	Very effective	Moderately effective	Somewhat effective	Not effective
Overall program organization (Calendars, scheduling, parking, etc.)	4	1	0	0
Overall organization of modern physics course	5	0	0	0
Overall organization of modern physics lab instruction	3	2	0	0
Pace of coverage of physics material	4	1	0	0
Modern Physics course to stimulate ideas for research-based H.S. instruction	3	2	0	0
Physics instruction to stimulate ideas for H.S. material (n=8)	5	0	0	0
Lab instruction to stimulate ideas for H.S. material	4	1	0	0
Time with other participants to stimulate ideas for H.S. material	3	2	0	0
Lecture material to help with teaching in H.S.	2	2	0	0
Lab experience to help with teaching strategies in H.S.	3	2	0	0
Teaching the application of modern physics to microelectronics	3	2	0	0
Teaching the principles of microelectronic packaging	2	1	1	0
Illustrating microelectronics research techniques	1	3	0	0

How satisfied were you with each of the following aspects of the Modern Physics course?

	Very satisfied	Moderately satisfied	Somewhat satisfied	Not satisfied
Knowledge of course instructor	5	0	0	0
Preparedness of course instructor	4	1	0	0
Lecture style used by course instructor	5	0	0	0
Required reading materials	2	2	0	0
Pace of course instructor	4	1	0	0
Content used for lab instruction	2	3	0	0
Balance of material that covered physics theory and practice	5	0	0	0

List of topics that teachers stated were most helpful to them as high school physics teachers:

Respondent 1: Quantum, electronics

Respondent 2: Link between waves and quantum mechanics

Respondent 3: I really liked how wave/boundary ideas as they apply to both quantum ideas and familiar problems were brought down to earth.

Respondent 4: Waves, Photoelectric Effect, Semiconductors

Respondent 5: How to tie the idea of waves in the boundary value problems and provide connections to the topics in physics.

Additions that teachers suggest for future summer courses:

Respondent 1: N/A

Respondent 2:

Respondent 3: Not to burden the instructor, nor, to introduce home work for participants, but if at certain break points it would help if instructor said “now try these problems to drive the point home if you wish; and here are where you can find the solutions.”

Respondent 4: If the teachers had only undergraduate education this course will be difficult. My graduate educator in physics helped me in recalling.

Other comments about the Modern Physics Course

Respondent 1: Very informative and approachable

Respondent 2: Thank you.

Respondent 3: Professor Conrad is very knowledgeable and approachable person. I am very satisfied with his lecture. For teachers without physics background this program will be difficult.

(D) STEP-UP: Findings 2008 Focus Group End-of-Course Discussion and Needs Assessment for Workshops and Laboratory Assignments

STEP-UP Focus Group Findings
Conducted July 21, 2008
Findings 2008 Focus Group Discussion and Needs Assessment N=6

Context for Focus Group
The primary objective of this focus group was to discuss and evaluate teacher experiences at the following three program workshops and one industry visit:

Workshop 1 June 18 Inquiry based teaching and State & National Science Standards Presented by George Stickel

Overall, the teachers responded positively to this workshop. They reported that he divided the physics' material that was covered at GT into sections and discussed how that material can be applied in the classroom. This was seen as an effective organizing tool. The group agreed that there was too much material to cover in the allotted time period. One of the specific comments was the usefulness of the inquiry-based material that was presented in the exercise format, although one teacher felt that they were "put on the spot." Another teacher said that the exercise helped to clarify how to creatively teach the physics' concepts.

The coverage of standards was just right according to these teachers. They reported that it was only the standards that were changing that Stickel discussed. This was a positive reflection since the teachers said they are all too familiar with science standards. Some illustrative quotes include the following:

- "This workshop was much more directed at methods for teaching – not repeating the standards"
- "Stickel should include the references for the material he used at the workshop."
- "He showed me more ways of contrasting material using concepts."

Workshop 2 June 26 Hands-on Teaching Tools and Methods
Presented by Michael Dowling

The teachers reported that Dowling covered teaching strategies for several concepts; however the response to his style was mixed. Most of the teachers said that they like the hands-on activities and will use his ideas. They also felt that he used the limited amount of time wisely. One teacher suggested that Dowling begin the workshop with the hands-on lessons so that he covers that component more fully. In contrast, one teacher felt that the discussion about the concepts was "too tedious" while another said that Dowling spent too much time elaborating on concepts. Most agreed that there was either too little time or too much material. One teacher that attended Dowling's workshop in 2007 reported that covering several concepts (2008 format) was preferable. Examples of these sentiments follow:

- "Really liked hands-on activities."
- "Too much talking will not use his tips."
- "Ran short on time."

General Comments
The teachers reflected on the challenge to relate the laboratory experience in STEP-UP to their high school classroom. One teacher suggested that even though it is difficult, that the STEP-UP participants should ask their faculty mentors to help them. Another said that even though the experience does translate directly, there are still ways to bring it to the classroom. The benefits of the STEP-UP resources were discussed by all teachers and the career information was particularly valuable even though teachers reported that it can be hard to use that material in class.

(E) STEP-UP: Findings 2008 Exit Survey Data and Teacher Comments
Administered Electronically
N=6

1. Would you recommend this program to your colleagues?

4 Definitely
2 Probably
0 Possibly, but not sure
0 No

2. Knowing what you know now, would you choose to participate in the STEP-UP program if you had it to do over again?

5 Definitely
0 Probably
1 Possibly, but not sure
0 No

3. Compared to other professional development programs in which you have participated, how would you rate the STEP-UP program?

4 One of the best
2 Better than many, but not one of the best
0 About average
0 Not as good as most

4. How would you rate the overall quality of your STEP-UP summer experience?

3 Excellent
3 Very good
0 Good
0 Fair
0 Poor

5. Based on how you feel now, did this summer experience influence your desire to pursue an advanced or an additional degree?

2 No influence
4 Increased desire to pursue degree
0 Decreased desire to pursue degree

6. Did this summer experience influence your desire to participate in another summer research program similar to STEP-UP?

1 No influence
5 Increased desire for additional research programs
0 Decreased desire for additional research programs

Teaching Perceptions and Experiences

Effectiveness of STEP-UP program at achieving each of the professional goals:

	Extremely Effective	Moderately Effective	Slightly Effective	Not Effective	Do not know
Increased my expertise in modern physics concepts	5	1	0	0	0
Increased my ability to use inquiry-based instructional methods	1	5	0	0	0
Enhanced my enthusiasm for teaching high school physics	3	3	0	0	0
Stimulated my commitment to being an effective teacher	2	4	0	0	0
Increased my confidence as a physics teacher	3	3	0	0	0
Enhanced my ability to teach the application of physics	3	3	0	0	0
Increased my ability to teach connection between physics & microelectronics	3	2	1	0	0
Increased my expertise needed to offer lab-based instruction for my students	1	4	1	0	0
Stimulated my interest to organize student field trips to Georgia Tech	3	2	1	0	0
Stimulated my dedication to encourage students to major in science/technology	4	2	0	0	0
Stimulated me to share what I learned with other teachers	4	2	0	0	0

STEP-UP Teacher Workshop Series

Quality of the following characteristics of the series of teacher workshops:

	Excellent	Very Good	Good	Fair	Poor
Clarity of workshop goals	0	6	0	0	0
Relevance of workshop material to my teaching needs	0	5	1	0	0
Relevance of reading materials to my teaching needs	0	4	2	0	0
Connection between teacher workshops and other STEP-UP modules	0	4	2	0	0
Opportunities to discuss teaching ideas during workshops	3	3	0	0	0
Quality of discussions about inquiry-based learning techniques	2	4	0	0	0
Opportunities to obtain feedback from other teacher participants	3	3	0	0	0

Usefulness of the content presented at each of the following workshops towards enriching the STEP UP experience:

	Extremely	Somewhat	Minimally	Not	Not

	Useful	Useful	Useful	Useful	Applicable
Workshop 1 (June 18) by George Stickel, Inquiry based teaching/standards	1	3	1	0	1
Workshop 2 (June 20) by Michael Dowling, Hands on teaching tools	3	2	1	0	0
Workshop 3 (July 21) Teacher workshop	1	1	0	0	4
Industry Visit (June 23) Georgia Power	2	1	1	0	2

Helpfulness of the workshops at addressing each of the following challenges faced by high school science teachers:

	Extremely Helpful	Somewhat Helpful	Minimally Helpful	Not Helpful	Not Applicable
Leading stimulating class discussions on physics topics	2	4	0	0	0
Using inquiry-based learning techniques to teach physics	3	3	0	0	0
Strategies to teach critical thinking skills	2	4	0	0	0
Teaching applied physics concepts	4	2	0	0	0
Adopting innovative methods to teach applied physics	1	5	0	0	0
Implementing hands-on physics projects	4	2	0	0	0
Using teaching methods to stimulate student interest in physics	2	4	0	0	0
Adapting the STEP-UP research experience to the classroom	0	6	0	0	0
Adapting inquiry-based learning to the high school environment	1	5	0	0	0
Adapting applied physics lessons to fit within the state curriculum standards	0	6	0	0	0

Research and Mentor Experience

Frequency of each of the following activities as part of ther research/lab experience with mentor:

	Regularly	Sporadically	Once or Twice	Not at All	Not Applic.
Attend lab/staff meetings	4	2	0	0	0
Attend brainstorming sessions	3	2	0	0	1
Work with other GT students	4	2	0	0	0
Review material needed for lab work	3	2	1	0	0
Assess progress on research assignment	5	0	0	0	0

	Great Extent	Moderate Extent	Small Extent	Not at All
To what extent was your mentor prepared for your research experience?	3	3	0	0
To what extent did your mentor understand the purpose of your STEP-UP program?	4	2	0	0
To what extent did you engage in research tasks that you can adapt to your classroom?	2	4	0	0
To what extent did your mentor develop clear research objectives for your experience?	5	1	0	0

To what extent did you understand your research assignment?	4	2	0	0
To what extent was your assignment appropriate to you level of understanding?	4	2	0	0
To what extent did you interact with your mentor?	5	1	0	0
To what extent did you feel welcome in the lab by your mentor?	6	0	0	0
To what extent did you interact with a graduate student assigned to you?	4	2	0	0
To what extent did the research experience enhance your understanding of applied research?	5	1	0	0

Overall STEP-UP Experience

Assessment of each portion of the STEP-UP program to help participants as high school science teachers:

	Extremely Helpful	Moderately Helpful	Minimally Helpful	Not Helpful	NA
Assigned reading materials	2	1	0	0	3
Modern physics course lecture	5	0	0	0	1
Lab sessions during modern physics course	4	1	0	0	1
Research experience in mentor's lab	5	1	0	0	0
Electronic Portfolio	2	4	0	0	0
STEP-UP teacher workshops	2	4	0	0	0

Below is a list of areas of instruction that were included in the STEP-UP program this summer. Amount of emphasis that should be placed on each component:

	Significantly too much Emphasis	Slightly too much Emphasis	About right Amount	Needed slightly more Emphasis	Needed significantly more Emphasis
Modern physics concepts	0	0	5	0	1
Application of modern physics to microelectronics	1	0	4	0	1
Principles of microelectronic packaging & technologies	1	0	3	1	1
Microelectronics research techniques	1	0	3	1	1
State-of-the-art packaging equipment/facilities	1	0	0	4	1
Adaptation of STEP-UP material for high school	1	0	2	3	0
Research lab experience with mentor	1	1	2	2	0
Electronic portfolio requirements	1	3	1	1	0

Comments - Most significant benefits to from the experience in the STEP-UP program:

1. Inquiry based teaching.

2. Refresher on modern physics and stimulating, high school appropriate demonstrations of electromagnetic phenomena in research area.

3. Renewing enthusiasm in my subject.

4. No response.

5. Modern Physics course and the research lab experiences.

6. Recalling the concepts in modern physics, experience with the advanced Physics labs and a chance to work with a professor learning about the current research in Physics.

Comments - How the STEP-UP experience will benefit the physics students:

1. Apply for research programs and I as a teacher would be able to guide the students with appropriate answers.

2. Enhanced my ability to offer "hands on" experiences and real world anecdotes.

3. Students can share insight in the university process.

4. No response.

5. Better instruction in modern physics and a teacher who is better to communicate the relevance of modern physics in everyday life.

6. This program helped me remember why I fell in love with Physics in the first place and my students will also get to hear and see how learning Physics helps one with critical thinking skills. By visiting Tech my students will see the applications of Physics to all other branches of engineering. Having a thorough understanding of basic concepts will help students with better career choices.

Comments - Component(s) of the STEP-UP program that could be improved or modified:

1. Research.

2. Offer optional homework (with solutions) in conjunction with modern physics. Develop a pre-screening questionairre to aid mentor in predetermining appropriate research walking in the door. While my mentor was helpful and flexible, it took me a while to find my purpose within the research environment. I think prior knowledge of my abilities would have aided my mentor in helping me to find the right "groove". Also, I think a workshop on participants sharing a favorite lab may have been a good workshop. Finally, I would like to offer the following observation, although I don't know if this would serve to improve the step-up program. Rather, it is more likely that this would improve teaching standards. There is a big disconnect between what Georgia Tech, the NSF and others (myself included) find important for the high school physics classroom and what those writing the standards find important. Standards, as they are now written, in my opinion, are greatly under on concepts in moderns physics and microelectronics.

3. The workshop meant to give us useful tools, demonstrations, etc, should actually do so, not just go over one fairly basic idea over and over.

4. No response.

5. The workshops seemed too much like normal staff development and didn't add anything new like the lectures and research did. In addition the schedule with the workshops was very full.

6. The workshops were done in a hurry. Longer time with clear goals would benefit teachers with lots of lab ideas to use in their classrooms.

(F) STEP-UP: Findings Mentor Survey
Administered Electronically

Descriptive Information

2008 STEP-UP Mentors

Greg Durgin Electrical Engineering
Phil First Physics
Ed Conrad Physics
CP Wong Materials Engineering
Venky Sundaran Materials & Electrical Engineering

Six teachers participated in the 2008-09 program (one participant was evaluated by 2 faculty mentors)

Previous participation as STEP-UP mentor:

Year	**# who were mentors**
2008	5
2007	3
2006	2
2005	1
2004	1

Primary contact for participant in the lab (multiple responses permitted):

Participants	**Possible Lab Contacts**			
	Faculty Mentor	Grad Student	Post Doc	Other faculty
1	X	X		
2	X	X		
3	X	X		
4	XX			
5	X			x
6	X			

Quality of STEP-UP participants for each of the following attributes:

	Excellent	**Good**	**Fair**	**Poor**
Willingness to work on assigned project	7	--	--	--
Ability to fit in at the lab	3	3	1	--
Motivation to learn about research	6	1	--	--
Resourcefulness to figure things out	3	1	3	--

Number of faculty mentors who would do each of the following:

	Definitely	**Probably**	**Maybe**	**No**
Recommend participant for other programs	5	2	--	--
Participate again as a STEP-UP mentor	3	2	--	--
Recommend this program to colleagues	5	--	--	--

Extent to which mentor experienced gains from participating in STEP-UP:

	Strongly agree	Agree	Disagree	Strongly disagree
Participating in this program was worth my time	2	3	--	--
This program was valuable to others in my lab	--	3	2	--
I believe STEP-UP is valuable for high school teachers	3	2	--	--
Participating as a mentor is meaningful to me	4	1	--	--

All faculty mentors were satisfied with the matching process for mentors and participants

(G) STEP-UP – Utilization of STEP-UP Experience – 2008 Teacher Participants
Electronically Administered February 2009 N=6

Please indicate with a check (√) if you have done any of the following activities for each of the academic years (AY) listed below.

	AY 2006-07	AY 2007-08	AY* 2008-09
1. Serve as advisor for a science or engineering club	**2**	**3**	**3**
2. Serve as advisor for extracurricular science/engineering competition	**2**	**3**	**2**
3. Work at summer science or engineering camp	**0**	**0**	**0**
4. Conducted workshop for other teachers on STEP-UP materials	**0**	**0**	**0**

How likely are you do any of the following activities during the next academic year (2009-10)?

	Definitely	Very Likely	Somewhat Likely	Not Likely
5. Serve as advisor for a science or engineering club	**2**	**2**	**1**	**0**
6. Work at summer science or engineering camp	**0**	**1**	**2**	**1**
7. Serve as advisor for extracurricular science/engineering competition	**2**	**2**	**1**	**0**
8. Bring class to Ga. Tech for field trip or other special event	**3**	**2**	**1**	**0**
9. Conduct workshop for other teachers on STEP-UP materials	**0**	**1**	**2**	**1**

10. Over the past year did you arrange for your high school students to come to Georgia Tech for field trips or other special events?

Respondent 1	No
Respondent 2	Once
Respondent 3	Once
Respondent 4	Once
Respondent 5	Once
Respondent 6	No

*If this activity is planned for the current academic year, but has not yet happened, please check and include date.

11. Description of projects or assignments used in class that resulted from the STEP-UP experience and if from whose electronic portfolio:

Project or Assignment	√ portfolio		
	Mine	Other	None
Respondent 1 I used the lab that I developed in my fall Modern Physics course, and I will likely use it again this semester when I get to light.	**x**		
Respondent 2 Taught a new unit on digital technology in my IB class drew a lot on my STEP-UP experience. Will be teaching a unit on modern physics utilizing the PPT I made for my electronic portfolio.	**x**		
Respondent 3 **No response**			**x**
Respondent 4 Will be using some of the lab ideas soon because this semester is for Modern Physics and fall is for Mechanics.		**x**	
Respondent 5 Wave modeling, ferro-fluids, polarization demo.			**x**
Respondent 6 Used the electricity & Magnetism lesson plan from other participants and tried to use research approach to teach the students.		**x**	

Number of times each of the following occurred how often have you done each of the following?

	Not at All	Once or twice	Several (3 – 7)	Many times (over 7)
12. Discussed during class engineering or science careers	**0**	**2**	**2**	**2**
13. Referred to summer STEP-UP experience during class	**0**	**2**	**2**	**2**
14. Discussed your summer STEP-UP	**0**	**2**	**3**	**1**

experience with other teachers				
15. Discussed with individual students engineering or science careers	**1**	**1**	**2**	**2**
16. Discussed real-life engineering examples during science class	**0**	**1**	**2**	**3**
17. Put materials acquired from STEP-UP program experience on display at school or classroom.	**0**	**4**	**2**	**0**
18. Shared engineering education flyers obtained from the STEP-UP program.	**2**	**4**	**0**	**0**
19. Shared engineering career video that obtained from the STEP-UP program.	**1**	**5**	**0**	**0**
20. Communicated with STEP-UP research faculty advisor	**1**	**4**	**1**	**0**
21. Communicated with STEP-UP lab graduate student mentor (1 missing)	**4**	**1**	**0**	**0**

Additional Comments:

Respondent 1:none

Respondent 2:none

Respondent 3:none

Respondent 4: I love GA Tech and very much enjoyed the STEP UP program. I want my students to get the world class engineering education from Tech.

Respondent 5: Motivated additional ideas for bringing physics to life for my students.

Respondent 6:none

The STEP-UP program has provided a comprehensive high school teacher research experience to **36** metro Atlanta physics teachers during the summers since 2004 at the research labs in microelectronics Packaging Research Center (PRC), School of Electrical and Computer Engineering (ECE), and School of Physics. The program was developed in collaboration with the Schools of Physics and Electrical and Computer Engineering at the Georgia Institute of Technology. The objective of this program has been to train metro Atlanta high school physics teachers in both modern physics concepts and their applications to engineering as well as their relevance to today's technology. The project had three components: (1) a two -week course on modern physics, with a laboratory component that enables teachers to fully take advantage of their subsequent research experience; (2) a two day module course on applications of modern physics concepts to microelectronics packaging; and (3) a five and a half week summer research experience. Participating teachers were expected to gain confidence in teaching physics and connect physics to engineering subjects and thus be able to better instill an interest application of physics to engineering in their students.

RECRUITMENT AND PARTICIPANT SELECTION

Since 2004, all the participating teachers have been recruited from the six metro Atlanta partner school systems. The program was advertised on the PRC and School of ECE web sites and by electronic announcements to the participating metro Atlanta school systems' science coordinators and high school principles. All the past participants taught in one of the following six school systems: Atlanta Public Schools, DeKalb County, Gwinnett County, Fulton County, Cobb County and Clayton County. In selecting the participants, priority was given to less experienced teachers with limited background in physics. The list of teachers who participated in the program over the past five years is provided in Table 1.

Table 1: STEP-UP Participants during 2004-2008

NAME	SUBJECTS TAUGHT	TEACHING EXPERIENCE	BS DEGREE	GENDER/ RACE	HS/SYSTEM	MINORITY STUDENT POPULATION
Estella Maria Bonilla	Physics	7 years	Physics	Female/ African American & Hispanic	Westlake HS, Fulton	99%
Jonnie Sue Fain	Physics & Chemistry	13 years	Physics	Female/ White	Riverdale HS, Clayton	87%
Robert Gabel	Physics	2 years	Textile Engineering	Male/ White	Druid Hills HS, DeKalb	49%
Kara Harris	Physics & Chemistry	5 years	Teaching of Chemistry	Female/ White	North Atlanta HS, Atlanta	85%
Brian Heglund	Physics & Physical Science	1 years	Philosophy	Male/ Asian	Centennial HS, Fulton	23%
Mahdi Ibrahim	Physics & Physical Science	15 years	Physics	Male/ African American	Southside HS, Atlanta	97%
John Robert Nice	Physics & Physical Science	10 years	Physics	Male/ White	South Gwinnett HS, Gwinnett	33%

William Reed	Physics	7 years	Mechanical Engineering	Male/ White	Roswell HS, Fulton	24%
William Bagot	Physics	20 years	Science Education	Male/ African American	Douglass HS, Atlanta	96%
Charles Jason Battles	Physics & Physical Science	8 years	Science Education	Male/ White	Mount Zion HS, Clayton	83%
Daniel Greer	Physics	4 years	Science Education	Male/ White	Jonesboro HS, Clayton	47%
Charles Fraley	Physics & Chemistry	21 years	Chemistry/ Physics	Male/ White	Dunwoody HS, DeKalb	48%
Anthony Osinski	Physics & Geometry	11 years	Science Education	Male/ White	Campbell HS, Cobb	64%
Janet Payne	Physics	8.5 years	Science Education	Female/ African American	Therrell HS, Atlanta	99%
Natasha Rachell	Chemistry & Physics	1 years	Biology	Female/ African American	Lithonia HS, DeKalb	97%
Elizabeth Walker	Physics	14 years	Physics & Computer Science	Female/ African American	North Cobb HS, Cobb	18%
Martin Aguilera	Physics	2 years	Mechanical Engineering	Male/ Hispanic	Harrison HS, Cobb	8%
Kent Ames	Physics	15 years	Physics	Male/ White	North Gwinnett HS, Gwinnett	12%
Rama Balachandran	Physics	16 years	Physics	Female/ Asian	Riverwood HS, Fulton	44%
Jeffrey Burmester	Physics	4 years	Electrical Engineering	Male/ White	Peachtree Ridge HS, Gwinnett	42%
Eugenia Duncan	Physics	3 years	Mechanical Engineering	Female/ African American	Martin Luther King HS, DeKalb	99%
Mike Lanham	Physics & Chemistry	10 years	Secondary Science Education	Male/ White	Sprayberry, Cobb	21%
Johnny McCord	Physics	10 years	Physics	Male/ White	South Cobb HS, Cobb	60%
Thomas Shyalama	Physics	12	Physics /Chemistry	Male/ Asian	Meadow Creek HS, Gwinnett	75%
Lanla Yilla	Physics, Chemistry, Physical Sci	12 years	Physics	Female/ African American	Stone Mountain HS, DeKalb	96%
Jeffrey Bourne	Physics	22 years	General Science	Male / White	Northview HS, Fulton	9%
Bhagyalakshmi Gopalsingh	Physical Science & Physics	20 years	Physics & Chemistry	Female / Asian	Jonesboro HS, Clayton	70%
Wesley Hunt	Chemistry & Physics	17 years	Biology	Male/ African American	DeKalb School of the Arts, DeKalb	86%
Kristan Marshall	Physics	2 years	Physics	Male / White	Meadowcreek HS, Gwinnett	73%

Karen Porter	Physics	11 years	Microbiology	Female/ White	Chamblee Charter HS, DeKalb	55%
Steven Thedford	Physics & Physical Science	15 years	Physics	Male/ African American	Redan HS, DeKalb	99%
William Daly	Physics	5 years	Electrical Engineering	Male/ White	Collins Hill HS, Gwinnett	30%
Molly Golladay	Physics	2 years	Physics	Female/ White	Kennesaw Mountain HS, Cobb	22%
Charulatha Krishnasamy	Physics	10 years	Physics	Female/ Asian	Duluth HS, Gwinnett	38%
Anita Nair	Physics & Physical Science	19 years	Physics	Female/ Asian	Creekside HS, Fulton	85%
William Stoll	Physics	6 years	Mechanical Engineering	Male/ White	Norcross HS, Gwinnett	58%

IMPLEMENTATION

As an example, the calendar for the 2008 offering of the STEP-UP program is provided below and details on the components of the program is discussed in the following sections.

March 15, 2008	Application deadline
April 1, 2008	Notification deadline
June 2, 2008	STEP-UP start date
June 18, 2008	STEP-UP teacher workshop I
June 23, 2008	Industry visit, Georgia Power Plant McDonough
June 26, 2008	STEP-UP teacher workshop II
July 10, 2008	STEP-UP teacher workshop III
July 21, 2008	STEP-UP teacher workshop IV
July 25, 2008	Last day of STEP-UP (presentation and banquet)
November 15, 2008	STEP-UP teacher workshop V
April 4, 2009	STEP-UP teacher workshop VI

The mornings of the first day of the program offerings were devoted to the STEP-UP orientation. The orientation consisted of presentations on program objectives, calendar and overview, what is expected of teachers to achieve, modern physics course content, summary on research projects. In addition, during the orientation the teachers completed the employment forms, toured the campus, and obtained their GT ID cards, computer accounts, parking permits and recreational center memberships. In the afternoon the teachers had lab safety training followed by the modern physics course.

Modern Physics Course (Weeks 1 & 2)

The unique aspect of this program was that it recognized that many high school physics teachers had a weak background in modern physics concepts and were not readily able to conduct research in microelectronics related fields. Therefore, the high school physics teachers were brought up to speed through an intense two-week modern physics lecture

and laboratory-based enhancement course. The topics covered and the experiments performed are provided below.

Day

1 Morning Orientation

Afternoon Mechanical waves to Quantum Mechanics: Wave Basics

1 Simple Harmonic waves,
2 traveling waves,
3 examples of traveling waves, water, sound and light
4 Fourier Analysis

2 Morning Wave Basics Continued

1 position and wave length composition of complex waves
2 wave uncertainty relationship (harbinger of uncertainty principle)
3 Interference and Diffraction

Afternoon Standing Waves

1 Standing waves from traveling waves
2 Principle of wave confinement and discrete standing wave modes
3 Examples of standing waves
Ropes, pipes and wave guides

3 Morning Basic Thermodynamics

1 Conservation of energy and the 1st law of thermo
2 Definition of temperature
3 Engines and Entropy: the 2nd Law of thermo
4 Ideal gas and heat capacity

Afternoon Modern Physics Labs

1) Wave-Particle Duality
2 Frank-Hertz
3 Photo electric effect

4 Morning Quantum Mechanics: Experimental evidence of the breakdown of Classical physics

1 Back-body spectrum
2 Emission lines from hydrogen
3 Photo electric effect
4 Temperature dependence of heat capacity

Afternoon Wave interpretation of matter

1 Particles as waves: standing wave confinement and discrete energy levels
2 Bohr atom
3 Quantization of space and angular momentum
4 Zeeman effect

5 Morning More Quantum Physics

1 Spin
2 Uncertainty principle and its meaning
3 Quantum oscillators, phonon, molecules and photons
4 Exclusion principle

Afternoon Modern Physics Labs continued

1 Wave-Particle Duality
2 Frank-Hertz
3 Photo electric effect

6 Morning Band structure
1 Free electron model
2 Origin of energy bands and band gaps

Afternoon Modern Physics Labs
1 Temp. dependence of metal and semiconductors
2 Hall effect

7 Morning Thermal Effects
1 phonons
2 thermal conductivity

Afternoon Instrumentation
1 Tunneling and STM and AFM
2 Photon spectroscopies: XPS and UPS
3 Electron Spectroscopies

8 Morning PN junction and transistors
1 n and p doping
2 pn junction
3 JFET transistor

Afternoon Modern Physics Labs continued
1 Temp. dependence of metal and semiconductors
2 Hall effect

9 Morning Instrumentation
1 Tunneling and STM and AFM
2 Photon spectroscopies: XPS and UPS
3 Electron Spectroscopies

Afternoon Review

10 Morning Review

Afternoon Post test and assessment

The teachers received 60 hours of modern physics instruction and they submitted requests to their school systems for Staff Development Units.

During the first two weeks, besides attending the lectures and labs teachers also spent time on completing their modern physics class notes and lab reports to be included in their electronic portfolios. In addition, during this period the teachers were assigned to the previously determined research projects according to their knowledge and skills, interests and types of courses they teach regularly.

Research Experience (Weeks 3-8)

The titles of the research projects completed by the past 36 participating teachers are provided in Table 2.

Table 2: STEP-UP Participants and Their Research Projects

TEACHER 'S NAME	STEP-UP MENTOR	RESEARCH PROJECT TITLE
Estella Maria Bonilla	Jianmin Qu	Effect of Acid Composition on Electrical Conduction of Silver Used in Electrically Conductive Adhesives
Jonnie Sue Fain	Madhavan Swaminathan	Debug and Measurement of Mixed Signal Modules and Design of Package Transmission Lines
Robert Gustave Gabel	Paul Kohl	Setup Computer Interface and Perform Characterization of an Automated Dielectric Dispense System
Kara Harris	Sue Ann Bidstrup Allen	Processing Advances for Fabrication of New High Modulus Thin Film Polymer Dielectrics
Brian Soyoung Heglund	CP Wong	Stress and Strain Measurements of Paper Samples
Mahdi Ibrahim	Ali Adibi	Automated Setup for Holographic Storage
John Robert Nice	GK Chang	Building an Optoelectronic Package and Modulus
William Reed	Yogendra Joshi	3D SOP - Digital Thermal Management
William Bagot	Madhavan Swaminathan	Design of a 3dB, 2.4 GHz Embedded Filter for a Wireless LAN
Jason Charles Battles	John Papapolymerou	MEMS - Micro Electrical Mechanical Systems (
Charles Fraley	Yogendra Joshi	Air Flow Rates in Server Farms
Daniel Greer	John Papapolymerou	Meteorological Applications of Patch Antenna Arrays on LCP
Anthony Osinski	GK Chang	Optical Waveguides for Chip-to-Chip Communication
Janet Payne	Paul Kohl	Air Gap Integration in Electrical Interconnections
Natasha Rachell	CP Wong	Underfill Materials
Elizabeth Walker	Ali Adibi	Material Optimization and System Demonstration for Persistent Read/Write Holographic Storage in LiNbO3:Fe:Mn Crystals
Martin Aguilera	Venky Sundaran/ Rao Tummala	Determination of Pre/Post Process Surface Roughness and Comparison with Copper Film Adhesion on Multiple Polymer Substrates
Kent Ames	Phil First	Characterizing Epitaxial Growth of Graphene on SiC
Rama Balachandran	Walt DeHeer	Graphite-New Foundation for microelectronic circuitry
Jeffrey Burmester	Paul Kohl	Micro Fuel Cell Vent Membranes
Eugenia Duncan	Bernard Kippelen	Silole Derivative Properties in Organic Light Emitting Diodes
Mike Lanham	Chaoray Hsieh/ Ali Adibi	Automation Procedures and Making Holograms
Johnny McCord	Daniel Guidotti/ GK Chang	Optical Data Transfer Using Polymer Structures
Thomas Shyalama	Madhavan Swaminathan/ Ege Engin	Multilayered Finite Difference Method for Characterization of Power /Ground Planes
Lanla Yilla	CP Wong	Effect of Filler Surface Modification on the Dielectric Properties of High-*k* Composite Materials
Jeffrey Bourne	Ali Adibi	Spectral Calibration of Ultra-High Resolution Volume Holographic Spectrometer
Bhagyalakshm	Greg Durgin	Transmission Characteristics of Frequency Selective Surface

i Gopalsingh		
Wesley Hunt	Venky Sundaran/ Rao Tummala	Polymer Based Packaging: EMAP Transposition and Chemical Etching
Kristan Marshall	Madhavan Swaminathan	Vector Network Analyzer Calibration
Karen Porter	CP Wong	An Alternative to Tin/Lead Solder: Isotropic Conductive Adhesives Filled With Silver Flake and Surface Functionalized Silver Nanoparticles
Steven Thedford	Bernard Kippelen	Hole Mobility Measurements of Poly(N-vinylcarbazole)
William Daly	Greg Durgin	Connection Between Backscatter Radio and Solar Cells
Molly Golladay	Phil First	Quantitative LEED Analysis Methods Using Pre-exising Mahematical Software
Charulatha Krishnasamy	Ed Conrad	The Interface Structure of a Few-layer Epitaxial Graphene Grown on 4H_SiC(0001)
Anita Nair	CP Wong	Epoxy Composite Thermal Interface Materials – Graphite Nanoplatelets
William Stoll	Rao Tummala	Improvement of Adhesion Between Dielectric and Seed Layer for Next Generation SOP

The research reports prepared by each teacher inclusive of research techniques, tools, and data associated with their research is located in their electronic portfolios located at the web site: www.ece.gatech.edu/academics/outreach/step-up/portfolios/index.html
login: STEPUP
password: physics

On the last day of the program, the teachers presented their research projects and how they are going to adapt their research experience to classroom activities during the school year. Each teacher's presentation is posted on the program web site at, www.ece.gatech.edu/academics/outreach/step-up/presentations/index.html

WORKSHOPS

Four workshops were held during the summer when teachers were on campus. These workshops focused on how to develop lesson plans and classroom material encompassing teachers' research experience and engineering undergraduate programs and careers. These workshops were instructed by Dr. George Stickel (Science Coordinator, Cobb County School District), Mr. Michael Dowling (Fernbank Science Center), Leyla Conrad and Ed Conrad (PIs), and the Rick Clark (Asst. Director, Admissions Office). The focus area of each workshop are provided below.

STEP-UP Teacher Workshop I – Inquiry Based Teaching (George Stickel)

- Introduction to inquiry based teaching and course development
- Developing student assessment which is aligned with project's physics concepts, National and state standards (QCC)

STEP-UP Teacher Workshop II – Hands-on Teaching Methods (Michael Dowling)

- Applications of "best practice" research for improving student achievement and the use of science inquiry in developing hands-on teaching tools and methods

STEP-UP Teacher Workshop III (Leyla Conrad & Rick Clark or Nancy Estes)

- Examples of lesson plans
- Engineering careers
- Admissions to Georgia Tech: criteria, application timeline, President's Scholarship Program

STEP-UP Teacher Workshop IV (Participants)

- Evaluation of progress and final formatting of developed lesson plans for classroom use and dissemination

TEACHER PORTFOLIOS

Each teacher prepared an electronic portfolio consisting of the following:

- Content, engineering applications, lab investigations, and pedagogical skills associated with key concepts in modern physics
- Tools, techniques, and special equipment utilized in teacher's microelectronics research
- Research report inclusive of research techniques, tools, data, discussion and conclusion associated with the research project
- Design of a lesson plan or unit (inclusive of assessment strategies) emanating from the research experience
- Engineering career information and educational preparation necessary to pursue them

On the last day of the program the teachers presented their lesson plans and research projects.

ACADEMIC YEAR ACTIVITIES

Fall and Spring Workshops

In addition to the four workshops described above, an additional half-day workshop was held in fall and another one in spring. Besides the current year participants all the past participants were invited to both of these workshops. The content of the workshops varied from year to year but examples of the topics covered are provided below,

- High School Physics and AP Physics enrollment trends.
- Electrical engineering and computer engineering enrollment trends.
- Teaching and learning resources in physics.
- How to share the developed lesson plans.
- How to keep communication going on with fellow teachers, mentors and STEP-UP administers - visits & lab tours to GaTech, GaTech students & faculty providing talks at teachers' high schools, etc.
- High school visits.
- Gender diversity in physics courses.

Campus Tours

The teachers continued to interact with the PI and Co-PI during the school year outside the fall and spring workshops. Fifteen high schools visited Georgia Tech during the past four years. During their campus visit, the groups attended a special admission session offered by the GT Admissions Office, had lunch at the student center, toured the modern physic laboratories and three of the Electrical and Computer Engineering labs. We keep the list of students who visited the campus and will check in the coming years to see how many of these students come to Tech. We strongly believe that providing STEP-UP teachers a workshop on admission processes and hosting their students on campus will be an effective recruitment method.

The PIs and GT students visited participant teachers' schools to observe instruction or participate in one of their school activities. Three ECE students and the PI attended the Youth Motivation Day at Douglass High School every year for three years.

PROGRAM ASSESSMENT

The primary objective of the assessment was to assure that the proposed enhancement courses and research experiences were as educationally effective as possible. As the program included several activities and components, the assessment methods used to review each activity varied appropriately. The cumulative assessment results presented in the major findings section refer to data from each of the following sources over the years 2004-2008. Each assessment method corresponds to a letter that is used in the text of the report and provided in the findings section for the last year (2008) of implementation:

Contents Include:

(A) STEP-UP: Findings Pre-Program Survey

(B) STEP-UP: Findings Pre-Test/Post-Test for Modern Physics Course

(C) STEP-UP: Findings End-of Course Evaluation Survey Data & Comments

(D) STEP-UP: Findings End-of-Course Needs Assessment Focus Group for Workshops and Laboratory Assignments Conducted July 23, 2007

(E) STEP-UP: Findings Exit Survey Data and Teacher Comments

(F) STEP-UP: Findings Mentor Survey

(G) STEP-UP: Findings Teacher Survey – Utilization of STEP-UP Experience